MS APPEAL BRIEF - PATENTS
PATENT
2185-0578P

IN THE U.S. PATENT AND TRADEMARK OFFICE

In re application of		Before the Board of Appeals	
Yoshinobu ONO et al.		Appeal No.:	
Appl. No.:	09/977,375	Group:	2811
Filed:	October 16, 2001	Examiner:	JUNGWHA IM
Conf.:	3053		
For:	3-5 GROUP COMPOUND SEMICONDUCTOR AND LIGHT-EMITTING ELEMENT		

APPEAL BRIEF TRANSMITTAL FORM

MS APPEAL BRIEF - PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

July 19, 2004
(Monday)

Sir:

Transmitted herewith is an Appeal Brief (in triplicate) on behalf of the Appellants in connection with the above-identified application.

☐ The enclosed document is being transmitted via the Certificate of Mailing provisions of 37 C.F.R. § 1.8.

A Notice of Appeal was filed on December 17, 2003.

☐ Applicant claims small entity status in accordance with 37 C.F.R. § 1.27

The fee has been calculated as shown below:

☒ Extension of time fee pursuant to 37 C.F.R. §§ 1.17 and 1.136(a) - $2,010.00.

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☐ Please charge Deposit Account No. 02-2448 in the amount of $0.00. A triplicate copy of this sheet is attached.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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Attachment(s)

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BRIEF ON APPEAL ON BEHALF OF APPELLANTS FILED UNDER PROVISIONS OF 37 C.F.R. § 1.192

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MS APPEAL BRIEF- PATENTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

July 19, 2004
(Monday)

Dear Sir:

This is an Appeal from the Final Rejection of June 16, 2003 of claims 1, 5-11 and 15 in the above-identified application.

I. REAL PARTY IN INTEREST

As evidenced by the Assignment filed January 10, 2002 and recorded at Reel 012451, Frames 0471-0473 the Real Party In Interest in connection with the present application is the Assignee of record, SUMITOMO CHEMICAL

COMPANY, LIMITED.

II. RELATED APPEALS AND INTERFERENCES

There are no pending Appeals or Interferences related to the present application known to the Appellants or the Appellants' Legal Representatives.

III. STATUS OF CLAIMS

Claims 1, 2 and 5-15 are pending in the application. Claims 12 and 13 have been withdrawn from consideration. Claims 1, 2, 5-11, 14 and 15 stand rejected.

IV. STATUS OF AMENDMENTS

An Amendment Under 37 C.F.R. § 1.111 was filed on January 21, 2003. A Reply Under 37 C.F.R. § 1.116 was filed on December 17, 2003. The Advisory Action of January 29, 2004 entered the Reply Under 37 C.F.R. § 1.116 for purposes of appeal.

V. SUMMARY OF INVENTION

The present invention pertains to a 3-5 compound semiconductor in which the dislocation density in epitaxial crystal layers can be reduced to be significantly lower than the dislocation density of the GaAs substrate. (Page 24, lines 1-3). This semiconductor includes a GaAs substrate, a buffer layer on the GaAs substrate and an epitaxial crystal layer on the buffer layer, and the layers are formed using an epitaxial crystal growth method. (Page 3, lines 15-19).

The buffer layer and the epitaxial crystal layer on the buffer layer are 3-5 group compound semiconductors each independently represented by the general formula $In_xGa_yAl_zAs$ (wherein, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $x+y+z=1$). (Page 3, lines 10-11). The buffer layer has a structure formed by laminating at least two kinds of layers having different compositions for n ($1 \leq n \leq 30$) times, where n is the number of repetitions of the two kinds of layers. (Page 7, lines 2-11) Also, the two kinds of layers are a $Ga_{1-z}Al_zAs$ layer (wherein $0<Z \leq 1$) and a GaAs layer. (Page 6, lines 21-22). The dislocation density in the epitaxial crystal layer on said buffer layer is $2000/cm^2$ or less. (Page 3, lines 23-24). Also, the dislocation density in said epitaxial crystal layer on the buffer layer is 1/3 or less of the dislocation density in said GaAs substrate. (Page 4, lines 7-10).

VI. ISSUES

The first issue presented for review is whether the combination of Mishima (U.S. Patent 5,633,516) in view of Udagawa (U.S. Patent 6,462,361) and Kizuki (U.S. Patent 5,948,161) suggests all of the elements set forth in claims 1, 6-11 to properly support a rejection under 35 U.S.C. § 103.

The second issue presented for review is whether the combination of Mishima (U.S. Patent 5,633,516) in view of Udagawa (U.S. Patent 6,462,361) and Inoue (U.S. Patent 5,134,446) suggests all of the elements set forth in claims 2 and 5 to properly support a rejection under 35 U.S.C. § 103.

These two issues are divided into Groups I-VII, which are separately argued below.

VII. GROUPING OF CLAIMS

The Appellants submit that claims 1, 2, 5-11 and 14-15 do not stand or fall together. Instead, the Appellants respectfully wish to group the claims as follows:

Group I: claims 1and 11;

Group II: claim 2;

Group III: claim 5;

Group IV: claim 6;

claim 7;

Group VI: claims 8, 9 and 10; and

Group VII: claims 14 and 15.

VIII. ARGUMENT

A. Group I, Claims 1 and 11

The combination of the Mishima, Udagawa and Kizuki fails to suggest all of the elements set forth in claims 1 and 11 to properly support a rejection under 35 U.S.C. § 103.

A.1. The Present Invention and its Advantages

The present invention pertains to a 3-5 group compound semiconductor (and corresponding light emitting element) that includes a GaAs substrate, a buffer layer over the GaAs substrate and an epitaxial crystal layer over the

buffer layer. The invention utilizes an $In_xGa_yAl_zAs$ epitaxial structure that does not contain P (phosphorous). The buffer layer suppresses the dislocation density in the epitaxial layer, as is discussed in the specification at page 3, lines 12-14.

The invention is typically embodied by claim 1, which sets forth:

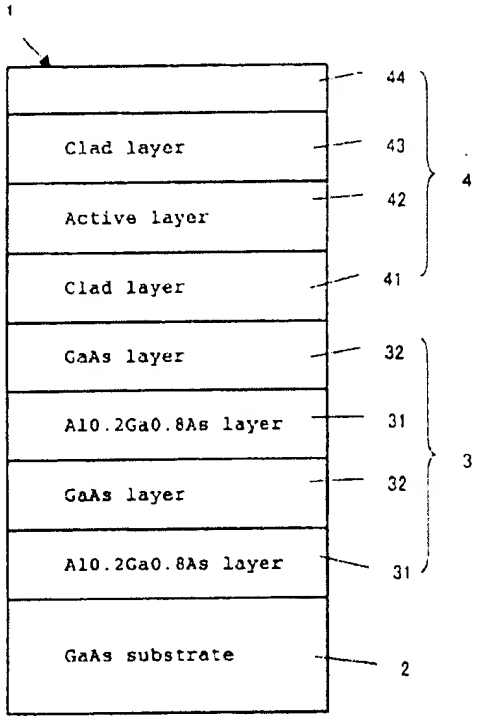
> 1. A 3-5 group compound semiconductor comprising a GaAs substrate, a buffer layer on said GaAs substrate and an epitaxial crystal layer on said buffer layer, said layers being formed by an epitaxial crystal growth method, wherein
>
> said buffer layer and said epitaxial crystal layer on said buffer layer are 3-5 group compound semiconductors each independently represented by the general formula $In_xGa_yAl_zAs$ (wherein, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $x+y+z=1$), and said buffer layer has a structure formed by laminating at least two kinds of layers having different compositions for n ($1 \leq n \leq 30$) times, where n is the number of repetitions of the two kinds of layers, and the two kinds of layers are a $Ga_{1-z}Al_zAs$ layer (wherein $0<Z \leq 1$) and a GaAs layer, and the dislocation density in the epitaxial crystal layer on said buffer layer is $2000/cm^2$ or less.

Independent claim 1 of the invention does not set forth indium content for the buffer layers. Rather, the technology of the invention sets forth a layer structure that minimizes dislocation density. The relationship between the inventive structure and dislocation density is discussed at pages 23 and 24 of the specification:

> If the structure of the 3-5 group compound semiconductor of the present invention is used, the dislocation density in epitaxial crystal layers can be reduced significantly lower than the dislocation density of a GaAs substrate. If a layer structure which can be utilized for electronic devices or optical devices is grown on the buffer layer of the present invention, a device excellent in properties manifesting no influence by dislocation can be produced, namely, such constitution is significantly valuable industrially. Further, when the buffer layers and epitaxial crystal

layers of the present invention is used, an epitaxial crystal layers of lower dislocation density can be produced even on a GaAs substrate with high dislocation density, consequently, a device excellent in properties can be obtained, to increase the degree of freedom in selecting substrates. Namely, this epitaxial film has a remarkably large industrial value.

A typical constitution of the inventive buffer layer is depicted in Figure 1 of the application, which is reproduced below.



The function of this construction is discussed at page 6, lines 2-9 of the specification:

In this embodiment, a buffer layer 3 which consist of superlattice structure is grown on a GaAs substrate 2, and a optical device layer 4 having a double hetero structure is grown on the buffer layer 3, and by this constitution, propagation of dislocation from the GaAs substrate 2 into the optical device layer 4 is suppressed, and the dislocation density in the optical device layer 4 is controlled to a level sufficiently smaller than the dislocation

density in the GaAs substrate 2.

A.2 Distinctions of the Invention Over Mishima, Udagawa and Kizuki

The indium-based technology of Mishima pertains to a lattice-mismatched crystal structure that includes a semiconductor film formed on a substrate with an intervening buffer layer. Figure 1 of Mishima is reproduced below.

FIG. 1

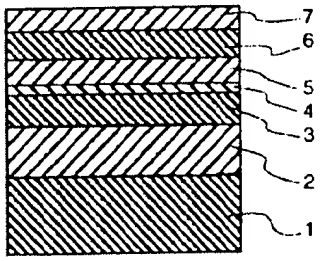


Figure 1 of Mishima shows a GaAs substrate 1 over which is found a buffer layer 2, an undoped InGaAs channel forming layer 3, an InAlAs spacer layer 4, a carrier supply layer 5, an undoped InAlAs layer 6 and a cap layer 7.

Mishima fails to disclose or suggest a buffer layer having multiple layers that are not formed by varying indium content. At page 2, lines 20-21 of the Office Action of June 18, 2003, the examiner admits to the failures of Mishima: "Mishima fails to teach that wherein [sic] the buffer layer has a structure of n times ($1 \leq n \leq 30$) of $Ga_{1-z}Al_zAs$ (wherein, $0 < z \leq 1$) layer and GaAs layer."

Although Mishima may disclose a multi-layered buffer layer, Mishima forms the buffer layer by varying the indium content. Mishima at column 3, lines 48-54 states "The InAlAs layer 2 comprises a plurality of layers formed by varying the ratio of thickness in each step of In composition in a first region where the In composition continuously varies, by varying the thickness of the buffer layer itself, and by varying the number of steps of In composition of the buffer layer."

In contrast, the present invention has a multilayer buffer formed from alternating layers of GaAs and $Ga_{1-z}Al_zAs$, and no variation of indium is required to form the two types of layers. The pending claims do not recite a limitation of varying indium content. Rather, a buffer layer is represented by a general formula that is clearly disclosed in Mishima at column 4, line 29 ($In_xAl_yGa_zAs$). Moreover, claims 1 and 2 of the invention recite a buffer layer as a GaAlAs/GaAs layer, clearly indicating that no indium is present in the buffer layer.

That is, the principle of operation of Mishima must be changed in order to use this reference to allege obviousness.

If the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified, then the teachings of the reference are not sufficient to render the claims *prima facie* obvious. In re Ratti, 270 F.2d 810, 123 U.S.P.Q. 349 (CCPA 1959).

Also, a person of ordinary skill would be motivated by Mishima to look at varying the indium content of the active layer. Indeed, Mishima looks to a

"lattice-mismatched crystal structure" (see, e.g., Mishima at column 6, lines 14-20) that can be analogized as being similar to the dislocation defects that the invention tries to eliminate. Mishima thus teaches away from the invention.

It is improper to combine references where the references teach away from their combination. In re Grasselli, 713 F.2d 731, 218 U.S.P.Q. 769, 779 (Fed. Cir. 1983).

As a result, a person having ordinary skill in the art would not be motivated to use the teachings of Mishima to form the multilayer of the invention.

The Examiner then turns to Udagawa.

In the final Office Action, the Examiner asserts: "Fig. 1 of Udagawa teaches a superlattice structured buffer layer (11) of AlGaAs/GaAs on a GaAs substrate (10)." Final Office Action at page 2, lines 21-23. Udagawa, however, relates to a GaInP epitaxial stacking structure that has a homogeneous indium composition. Udagawa at column 4, lines 31-36 states: "Therefore, a third object of the present invention is to provide an epitaxial stacking structure comprising a buffer layer for forming a $Ga_YIn_{1-Y}P$ ($0<Y\leq 1$) electron-supply layer that has high resistance suitable for reducing the leakage current and that has a homogeneous indium composition."

Independent claims 1 and 2 of the invention, however, set forth a formula $In_xGa_yAl_zAs$ where the amount of indium x can vary between 0 and 1. This limitation had been re-incorporated into claims 1 and 2 to conform with

the Examiner's observation of allowability made during the interview of January 15, 2003. The Interview Summary stated:

> We discussed the buffer layers of Mishima et al., which include In. Applicant proposes that claim 4, which specifies a buffer that does include In, could be combined with the independent claims (1 and 2) to overcome the Mishima reference. Examiner agrees that the buffer layer of claim 4 would not include In, and would overcome the rejection based on the reference teaching of a buffer layer that does include In.[1]

Further, Udagawa is silent regarding reducing the dislocation density in the epitaxial crystal layer.

As a result, a person having ordinary skill would not combine Mishima and Udagawa to produce a claimed embodiment of the invention.

The Examiner turns to Kizuki for teachings pertaining to dislocation density. Kizuki, however, fails to address the inability of Mishima and Udagawa to suggest the invention.

Also, to establish a *prima facie* case of obviousness, it is necessary for the Examiner to present evidence, preferably in the form of some teaching, suggestion, incentive, or inference in the implied prior art, or in the form of generally available knowledge, that one having ordinary skill in the art would have been lead to use the relevant teachings of the implied references in the proposed manner asserted by the Examiner to arrive at the invention. See Ex parte Levengood, 28 U.S.P.Q.2d 1300 (B.P.A.I. 1993). Because the Examiner bears the initial burden of presenting a *prima facie* case of obviousness, if this

[1] However, Udagawa was found in search performed subsequent to the Interview.

burden is not met, then the burden of coming forth with evidence or argument does not shift to the Applicant. In re Rijckaert, 9 F.2d 1531, 28 U.S.P.Q.2d 1955 (Fed. Cir. 1993). Likewise, where an Examiner fails to establish a proper *prima facie* case, the rejection is improper, and should be overturned. In re Fine, 837 F.2d 1071, 5 U.S.P.Q.2d 1596 (Fed. Cir. 1988).

Further, it is impermissible to allege *prima facie* obviousness through hindsight reconstruction of the invention. The rigorous burden placed upon the Examiner for establishing *prima facie* obviousness has been emphasized by the United States Court of Appeals for the Federal Circuit in In re Sang Su Lee, 277 F.3d 1338, 61 U.S.P.Q.2d 1430 (Fed. Cir. 2002). In Sang Su Lee, the court states:

> As applied to the determination of patentability vel non when the issue is obviousness, "it is fundamental that rejections under 35 U.S.C. §103 must be based on evidence comprehended by the language of that section." In re Grasselli, 713 F.2d 731, 739, 218 USPQ 769, 775 (Fed. Cir. 1983). The essential factual evidence on the issue of obviousness is set forth in Graham v. John Deere Co., 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966) and extensive ensuing precedent. The patent examination process centers on prior art and the analysis thereof. When patentability turns on the question of obviousness, the search for and analysis of the prior art includes evidence relevant to the finding of whether there is a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness. See, e.g., McGinley v. Franklin Sports, Inc., 262 F.3d 1339, 1351-52, 60 USPQ2d 1001, 1008 (Fed. Cir. 2001) ("the central question is whether there is reason to combine [the] references," a question of fact drawing on the Graham factors).
>
> "The factual inquiry whether to combine references must be thorough and searching." Id. It must be based on objective evidence of record. This precedent has been reinforced in myriad decisions, and cannot be dispensed with. See, e.g., Brown & Williamson Tobacco Corp. v. Philip Morris Inc., 229 F.3d 1120,

> 1124-25, 56 USPQ2d 1456, 1459 (Fed. Cir. 2000) ("a showing of a suggestion, teaching, or motivation to combine the prior art references is an 'essential component of an obviousness holding'") (quoting C.R. Bard, Inc., v. M3 Systems, Inc., 157 F.3d 1340, 1352, 48 USPQ2d 1225, 1232 (Fed. Cir. 1998)); In re Dembiczak, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999) ("Our case law makes clear that the best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references."); In re Dance, 160 F.3d 1339, 1343, 48 USPQ2d 1635, 1637 (Fed. Cir. 1998) (there must be some motivation, suggestion, or teaching of the desirability of making the specific combination that was made by the applicant); In re Fine, 837 F.2d 1071, 1075, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988) ("'teachings of references can be combined only if there is some suggestion or incentive to do so.'") (emphasis in original) (quoting ACS Hosp. Sys., Inc. v. Montefiore Hosp., 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984)).

The need for specificity pervades this authority. See, e.g., In re Kotzab, 217 F.3d 1365, 1371, 55 U.S.P.Q.2d 1313, 1317 (Fed. Cir. 2000) ("particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected these components for combination in the manner claimed"); In re Rouffet, 149 F.3d 1350, 1359, 47 U.S.P.Q.2d 1453, 1459 (Fed. Cir. 1998) ("even when the level of skill in the art is high, the Board must identify specifically the principle, known to one of ordinary skill, that suggests the claimed combination. In other words, the Board must explain the reasons one of ordinary skill in the art would have been motivated to select the references and to combine them to render the claimed invention obvious."); In re Fritch, 972 F.2d 1260, 1265, 23 U.S.P.Q.2d 1780, 1783 (Fed. Cir. 1992) (the examiner can satisfy the burden of showing obviousness of the combination "only by showing some objective teaching in

the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references"). In re Sang Su Lee, at 277 F.3d at 1342.

A person having ordinary skill in the art would therefore not be motivated to produce the invention as embodied in claims 1 and 11 of Group I by the combination of Mishima, Udagawa and Kizuki. Claims dependent upon claims 1 are patentable for at least the above reasons.

Accordingly, a *prima facie* case of obviousness has thus not been made.

A.3 Summary

As has been shown, the Examiner has failed to establish a *prima facie* case of obviousness over the combination of Mishima, Udagawa and Kizuki. Mishima teaches away from the invention. The principal of operation of Mishima must be changed in order to utilize this reference to allege obviousness. The combination of the references is therefore clearly accomplished through impermissible hindsight reconstruction. Appellants therefore respectfully submits that the combination of elements as set forth in independent claim 1 (and dependent claim 11) of Group I is not obvious by the combination of Mishima, Udagawa and Kizuki, for the reasons explained above.

Accordingly, reversal of the Examiner's rejection based on the above arguments is respectfully requested.

B. Group II, Claim 2

The combination of Mishima, Udagawa and Inoue fails to suggest all of

the elements set forth in claim 2 to properly support the rejection of Group II under 35 U.S.C. § 103.

The failures of the Mishima and Udagawa have been discussed above, and the general discussion thereof is incorporated here, but is not being repeated here so as to avoid repetition. Also, independent claim 2 contains all the structural information set forth in claim 1 (Group I), except that the dislocation density in the epitaxial crystal layer on the buffer layer is defined as being 1/3 or less of the dislocation density of the GaAs substrate.

That is, claim 2 sets forth:

> 2. A 3-5 group compound semiconductor comprising a GaAs substrate, a buffer layer on said GaAs substrate and an epitaxial crystal layer on said buffer layer, said layers being formed by an epitaxial crystal growth method, wherein
>
> said buffer layer and said epitaxial crystal layer on said buffer layer are 3-5 group compound semiconductors each independently represented by the general formula $In_xGa_yAl_zAs$ (wherein, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $x+y+z=1$), and said buffer layer has a structure formed by laminating at least two kinds of layers having different compositions for n ($1 \leq n \leq 30$) times, where n is the number of repetitions of the two kinds of layers, and the two kinds of layers are a $Ga_{1-z}Al_zAs$ layer (wherein $0 < Z \leq 1$) and a GaAs layer, and the dislocation density in said epitaxial crystal layer on the buffer layer is 1/3 or less of the dislocation density in said GaAs substrate.

As discussed above, Mishima teaches away from the invention and the principal of operation of Mishima must be changed in order to utilize this reference to allege obviousness. Mishima thus cannot be combined with Udagawa to allege obviousness.

The Examiner turns to Inoue for teachings pertaining to dislocation

defects. Inoue, however, fails to address the inability of one of ordinary skill to combine Mishima with Udagawa.

Further, combining Mishima, Udagawa and Inoue can only be accomplished by impermissible hindsight reconstruction. The rigorous requirements for avoiding hindsight reconstruction have been discussed above.

A *prima facie* case of obviousness over claim 2 of Group II has thus not been made over Mishima, Udagawa and Inoue.

Accordingly, reversal of the Examiner's rejection based on the above arguments is respectfully requested.

C. ***Group III, Claim 5***

The combination of the Appellants' disclosure with Mishima, Udagawa and Inoue (or Mishima, Udagawa and Kizuki) fails to suggest all of the elements set forth in claim 5 to properly support the rejection of Group III under 35 U.S.C. § 103.

The failures of the combination of the Appellants' disclosure with Mishima, Udagawa and Inoue (and Kizuki) have been discussed above, and the general discussion thereof is incorporated here, but is not being repeated here so as to avoid repetition. Also, claims 5 depends upon claim 1 (Group I) or claim 2 (Group II), and all of the distinctions of the invention over Groups I and II are equally applicable to Group III.

Claim 5 contains the additional distinction that the value of z is 0.01 or

more and 0.4 or less.

At page 5 of the Office Action of June 18, 2003, the Examiner turns to Inoue's gallium indium arsenide layer and states: "Although, the buffer layer of Inoue is made of $Ga_{1-z}In_zAs$, it is also taught that In can be replaced with other Group II elements such as B or Al (col. 7, lines 20-23)." Inoue at column 7, lines 20-23 contains the blanket statement: "As already described, the element incorporated in the GaAs buffer layer 14 is not limited to In but other group III elements, such as B or Al, nay be used." As a result, using this omnibus teaching of Inoue to derive the preferred 0.01-0.4 range of z in the $Ga_{1-z}Al_zAs$ buffer layer can only be achieved by utilizing hindsight reconstruction.

As a result, the invention as embodied in claim 5 of group III are patentable for these additional reasons as well. Thus, *prima facie* obviousness has not been shown over Group III.

Accordingly, reversal of the Examiner's rejection based on the above arguments is respectfully requested.

D. Group IV, Claim 6

The combination of the Appellants' disclosure with Mishima, Udagawa and Kizuki (or Mishima, Udagawa and Inoue) fails to suggest all of the elements set forth in claim 6 to properly support the rejection of Group IV under 35 U.S.C. § 103.

The failures of the combination of the Appellants' disclosure with

Mishima, Udagawa and Kizuki (and Inoue) have been discussed above, and the general discussion thereof is incorporated here, but is not being repeated here so as to avoid repetition. Also, claims 6 depends upon claim 1 (Group I) or claim 2 (Group II), and all of the distinctions of the invention over Groups I and II are equally applicable to Group IV.

Claim 6 contains the additional limitation that at least one layer of the two kinds of layers is doped with an n-type dopant. At page 3, lines 12-13 of the Office Action mailed June 18, 2003, the Examiner states: "Regarding claim 6, Mishima shows that at least one layer of two kinds of layers in the buffer layer is doped with an n-type dopant (col. 5, lines 22 and col. 4, lines 28-34)." Mishima at column 5, line 22 discloses "an n-type InGaAs buffer layer."

However, this teaching of Mishima fails to address the inability to combine the indium-specific technology of Mishima with Udagawa (and Kizuki and Inoue) to produce a claimed embodiment of the invention. A *prima facie* case of obviousness has not been made over claim 6 of Group IV for this additional reason as well.

Accordingly, reversal of the Examiner's rejection based on the above arguments is respectfully requested.

E. Group V, Claim 7

The combination of the Appellants' disclosure with Mishima, Udagawa and Kizuki (or Mishima, Udagawa and Inoue) fails to suggest all of the elements

set forth in claim 7 to properly support the rejection of Group V under 35 U.S.C. § 103.

The failures of the combination of the Appellants' disclosure with Mishima, Udagawa and Kizuki (and Inoue) have been discussed above, and the general discussion thereof is incorporated here, but is not being repeated here so as to avoid repetition. Also, claims 7 depends upon claim 6 (Group IV), which covers Groups I, II and IV, and all of the distinctions of the invention over Groups I, II and IV are equally applicable to Group V.

Claim 7 contains the additional limitation that the n-type dopant is Si and the concentration of this Si is 1×10^{17} cm^{-3} or more and 5×10^{18} cm^{-3} or less.

At page 3, lines 14-15 of the Office Action mailed June 18, 2003, the Examiner states: "Regarding claim 7, Mishima shows that said n-type dopant is Si and the concentration is 1×10^{17} cm^{-3} ***or less*** (Col. 5, lines 43-45)." (Emphasis added). However, claim 7 of the invention sets forth "1×10^{17} cm^{-3} ***or more*** and 5×10^{18} cm^{-3} or less." (Emphasis added) However, Mishima at column 5, lines 43-45 states: "Silicon was employed as a dopant for determining the conductivity type of the n-type layers, which were doped to 2×10^{18} cm^{-3}."

However, this teaching of Mishima fails to address the inability to combine the indium-specific technology of Mishima with Udagawa (and Kizuki and Inoue) to produce a claimed embodiment of the invention. A *prima facie* case of obviousness has not been made over claim 7 of Group V for this additional reason as well.

Accordingly, reversal of the Examiner's rejection based on the above arguments is respectfully requested.

F. Group VI, Claims 8, 9 and 10

The combination of the Appellants' disclosure with Mishima, Udagawa and Kizuki (or Mishima, Udagawa and Inoue) fails to suggest all of the elements set forth in claims 8, 9 and 10 to properly support the rejection of Group V under 35 U.S.C. § 103.

The failures of the combination of the Appellants' disclosure with Mishima, Udagawa and Kizuki (and Inoue) have been discussed above, and the general discussion thereof is incorporated here, but is not being repeated here so as to avoid repetition. Also, each of claims 8 and 9 depends upon claim 1 (Group I) or claim 2 (Group II), and all of the distinctions of the invention over Groups I and II are equally applicable to Group IV. Similarly, claim 10 depends upon claim 8 to thus incorporate all the arguments set forth in Group I and Group II.

Claim 8 contains the additional limitation that the n-type dopant is planar-doped in at least one layer of said two kinds of layers. Claim 9 contains the additional limitation that the n-type dopant is planar-doped on the interface of at least one layer of said two kinds of layers. Claim 10 contains the additional limitation that the n-type dopant is Si and the planar-doping concentration of this Si is 1×10^{11} cm^{-2} or more and 5×10^{12} cm^{-2} or less.

At page 3, lines 16-20 of the Office Action mailed June 18, 2003, the

Examiner states:

> Regarding claims 8-10, Mishima shows that the buffer layer is doped with n type Si dopant as discussed above in claims 6 and 7. Regarding the planar doping concentration, Mishima teaches the concentration of Si in terms of volume as discussed in claim 7, which the instant claim recites the identical concentration in term of surface area.

That is, the disclosure of Mishima regarding claim 7, discussed above, teaches ***volume*** doping of 2×10^{18} cm^{-3}.

In contrast, page 8, lines 1-11 of the Appellants' specification discusses the specific nature of ***planar*** doping:

> Doping is conducted uniformly into a layer constituting a buffer layer as above, however, as the additional method, so-called planar-doping can be effected, in which doping is conducted only on a specific plane in the layer, to obtain the same effect. The position of a plane on which planar-doping is effected may be inside of the layers or at the interface of two kinds of layers. At any position, the concentration of planar-doping is effectively and preferably 1×10^{11} cm^{-2} or more and 5×10^{12} cm^{-2} or less.

As a result, the Examiner's position equating planar doping with the volume doping of Mishima fails. Mishima thus clearly fails to disclose or suggest the planar doping of claims 8-10. A *prima facie* case of obviousness has not been mad for these additional reasons as well.

Accordingly, reversal of the Examiner's rejection based on the above arguments is respectfully requested.

G. Group VII, Claims 14 and 15

The combination of the Appellants' disclosure with Mishima, Udagawa and Kizuki (or Mishima, Udagawa and Inoue) fails to suggest all of the elements set forth in claims 14 and 15 to properly support the rejection of Group V under 35 U.S.C. § 103.

The failures of the combination of the Appellants' disclosure with Mishima, Udagawa and Kizuki (and Inoue) have been discussed above, and the general discussion thereof is incorporated here, but is not being repeated here so as to avoid repetition. Also, each of claims 14 and 15 depends upon claim 1 (Group I) or claim 2 (Group II), and all of the distinctions of the invention over Groups I and II are equally applicable to Group IV.

Claim 14 contains the additional limitation that the number of repetitions of the two types of layers n is 2 to 30. Claim 15 has the limitation that n is 2 to 20.

At page 5, lines 17-18 of the Office Action mailed June 18, 2003, the Examiner states: "Regarding claims 14 and 15, Udagawa teaches a superlattice buffer layers (col. 4, lines 19-23)." Udagawa at column 4, lines 19-23 states: "In addition, in the buffer layers consisting of the conventional constitution such as AlGaAs/GaAs superlattice buffer layers, there are problems regarding the DC properties (static properties) of the transistor . . ." This teaching of Udagawa clearly fails to disclose or suggest n is 2 to 30 (claim 14) or n is 2 to 20 (claim 15). Also, this passage of Udagawa discusses the disadvantages of superlattice

structure buffer layers. Udagawa would thus teach away from the invention when considered by a person having ordinary skill in the art.

It is improper to combine references where the references teach away from their combination. In re Grasselli, 713 F.2d 731, 218 U.S.P.Q. 769, 779 (Fed. Cir. 1983).

As a result, Udagawa fails to suggest the invention's limitations embodied in claims 14 and 15. Thus, *prima facie* obviousness has not been demonstrated.

Accordingly, reversal of the Examiner's rejection based on the above arguments is respectfully requested.

H. Conclusion

Appellants have demonstrated that the Examiner has failed to successfully allege that the rejected claims are *prima facie* obvious. It is clear that the inventive semiconductor with its dislocation minimizing buffer structure is patentable over the cited prior art. For the reasons advanced above, it is respectfully submitted that all claims in this application are allowable. Thus, favorable reconsideration and reversal of the Examiner's rejection of claims 1, 2, 5-11, 14 and 15 under 35 U.S.C. § 103, by the Honorable Board of Patent Appeals and Interferences, are respectfully solicited.

The required Appeal Brief fee in the amount of $330.00 is attached hereto.

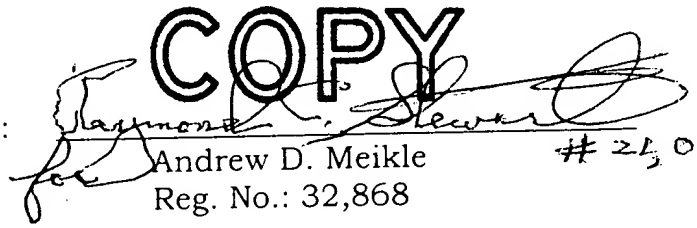
Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), Applicant(s) respectfully

petition(s) for a five (5) month extension of time for filing a reply in connection with the present application, and the required fee of $2010.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and further replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fee required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By: 
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Attachment: APPENDIX A

APPENDIX A
CLAIMS ON APPEAL

1. (Previously Presented) A 3-5 group compound semiconductor comprising a GaAs substrate, a buffer layer on said GaAs substrate and an epitaxial crystal layer on said buffer layer, said layers being formed by an epitaxial crystal growth method, wherein

said buffer layer and said epitaxial crystal layer on said buffer layer are 3-5 group compound semiconductors each independently represented by the general formula $In_xGa_yAl_zAs$ (wherein, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $x+y+z=1$), and said buffer layer has a structure formed by laminating at least two kinds of layers having different compositions for n ($1 \leq n \leq 30$) times, where n is the number of repetitions of the two kinds of layers, and the two kinds of layers are a $Ga_{1-z}Al_zAs$ layer (wherein $0<Z \leq 1$) and a GaAs layer, and the dislocation density in the epitaxial crystal layer on said buffer layer is $2000/cm^2$ or less.

2. (Previously Presented) A 3-5 group compound semiconductor comprising a GaAs substrate, a buffer layer on said GaAs substrate and an epitaxial crystal layer on said buffer layer, said layers being formed by an epitaxial crystal growth method, wherein

said buffer layer and said epitaxial crystal layer on said buffer layer are 3-5 group compound semiconductors each independently represented by the general formula $In_xGa_yAl_zAs$ (wherein, $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $x+y+z=1$), and said

buffer layer has a structure formed by laminating at least two kinds of layers having different compositions for n ($1 \leq n \leq 30$) times, where n is the number of repetitions of the two kinds of layers, and the two kinds of layers are a $Ga_{1-z}Al_zAs$ layer (wherein $0<Z\leq 1$) and a GaAs layer, and the dislocation density in said epitaxial crystal layer on the buffer layer is 1/3 or less of the dislocation density in said GaAs substrate.

3-4. (Cancelled)

5. (Previously Presented) The 3-5 group compound semiconductor according to claim 1 or 2, wherein the value of said z is 0.01 or more and 0.4 or less.

6. (Previously presented) The 3-5 group compound semiconductor according to claim 1 or 2, wherein at least one layer of said two kinds of layers is doped with an n-type dopant.

7. (Original) The 3-5 group compound semiconductor according to Claim 6 wherein said n-type dopant is Si and the concentration of this Si is 1×10^{17} cm^{-3} or more and 5×10^{18} cm^{-3} or less.

8. (Previously Presented) The 3-5 group compound semiconductor according to claim 1 or 2, wherein an n-type dopant is planar-doped in at least

one layer of said two kinds of layers.

9. (Previously Presented) The 3-5 group compound semiconductor according to claim 1 or 2, wherein an n-type dopant is planar-doped on the interface of at least one layer of said two kinds of layers.

10. (Previously Presented) The 3-5 group compound semiconductor according to claim 8 wherein said n-type dopant is Si and the planar-doping concentration of this Si is 1×10^{11} cm^{-2} or more and 5×10^{12} cm^{-2} or less.

11. (Previously Presented) A light-emitting element comprising the 3-5 group compound semiconductor of claim 1.

12. (Withdrawn) A method of measurement of dislocation density in epitaxial crystal comprising the steps of: irradiating an epitaxial crystal with laser light having a wavelength shorter than that corresponding to the bandgap energy of crystal composition; measuring the in-surface distribution of the peak intensity of thus-obtained photo-luminescent light; and calculating the dislocation density (N $cm^{\square 2}$) from the number (n) of dark spots or dark lines and the area (S cm^2) of measurement region, according to the following formula (I).

$$N=n/S \qquad (I)$$

13. (Withdrawn) A method of measurement of dislocation density, according to Claim 12, wherein the epitaxial crystal is composed of a plurality of layers, and the dislocation density is calculated for each layer.

14. (Previously Presented) The 3-5 group compound semiconductor according to claim 1 or 2, wherein n is 2 to 30.

15 .(Previously Presented) The 3-5 group compound semiconductor according to claim 1 or 2, wherein n is 2 to 20.